Ch 5 Control System

1 interPolation types:

- Linear interPolation.
- Circular interPolation
- Parabolic interPolation

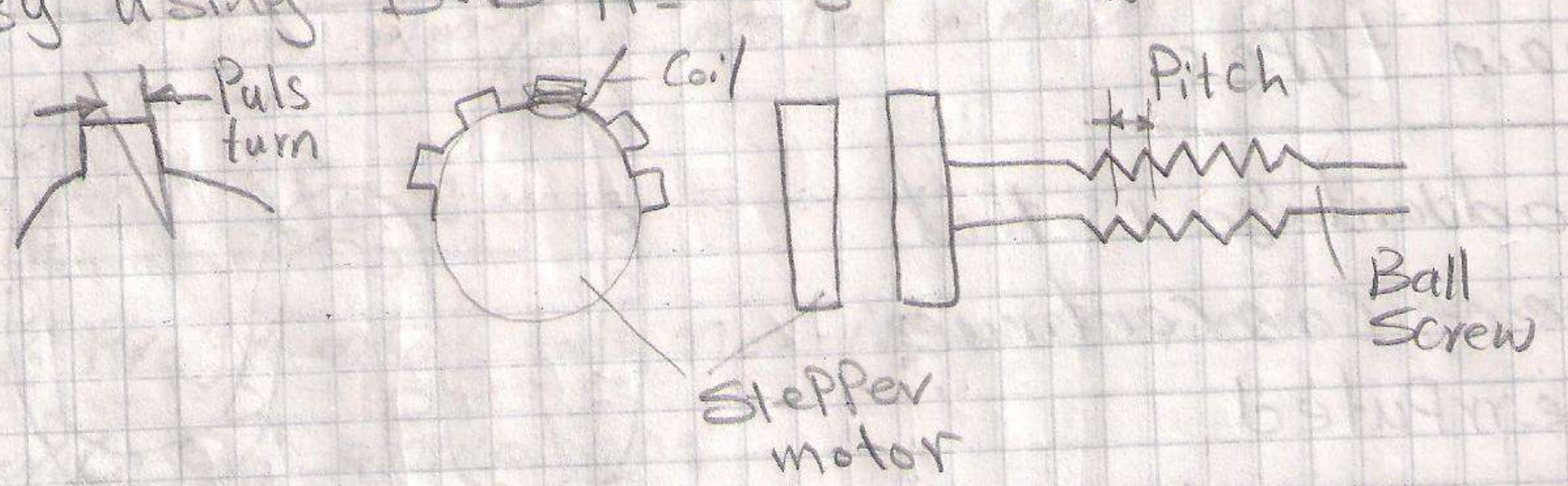
الماكينة تتحرك في X او Y وينتج interPolation عندما نقسم كل مسار معين

2 interPolation Can be Performed by:

- Digital interPolation.
- Analogue interPolation.
- Soft interPolation.

3 Digital interPolation:

By using D.D.A = digital differential analyzer



الملف يقوم بتوليد مجال مغناطيسي يعمل على حركة العمود بزاويه

$$\text{Puls turns} = \frac{360}{\text{زاوية الخطوة}} \quad \text{for Stepper motor in de}$$

$$\text{Resolution} = \text{Pitch of ball screw} * \frac{\text{Puls}}{\text{turn}} \quad \text{mm/Puls}$$

$$V_{max}^{x} = \text{max Puls rate} \quad \text{P.P.S (Puls/sec)}$$

V_{max} = max. transvere speed mm/min

$V_{max} = V^{*}_{max} * resolution * 60$

$V_L = F$ = required feed in part program, mm/min

or

$V_L = F * S$ (rev/min, rpm)

L_{max} = maximum transvere distance

$L_{max} = X_{max} = Y_{max} = R_{max}$

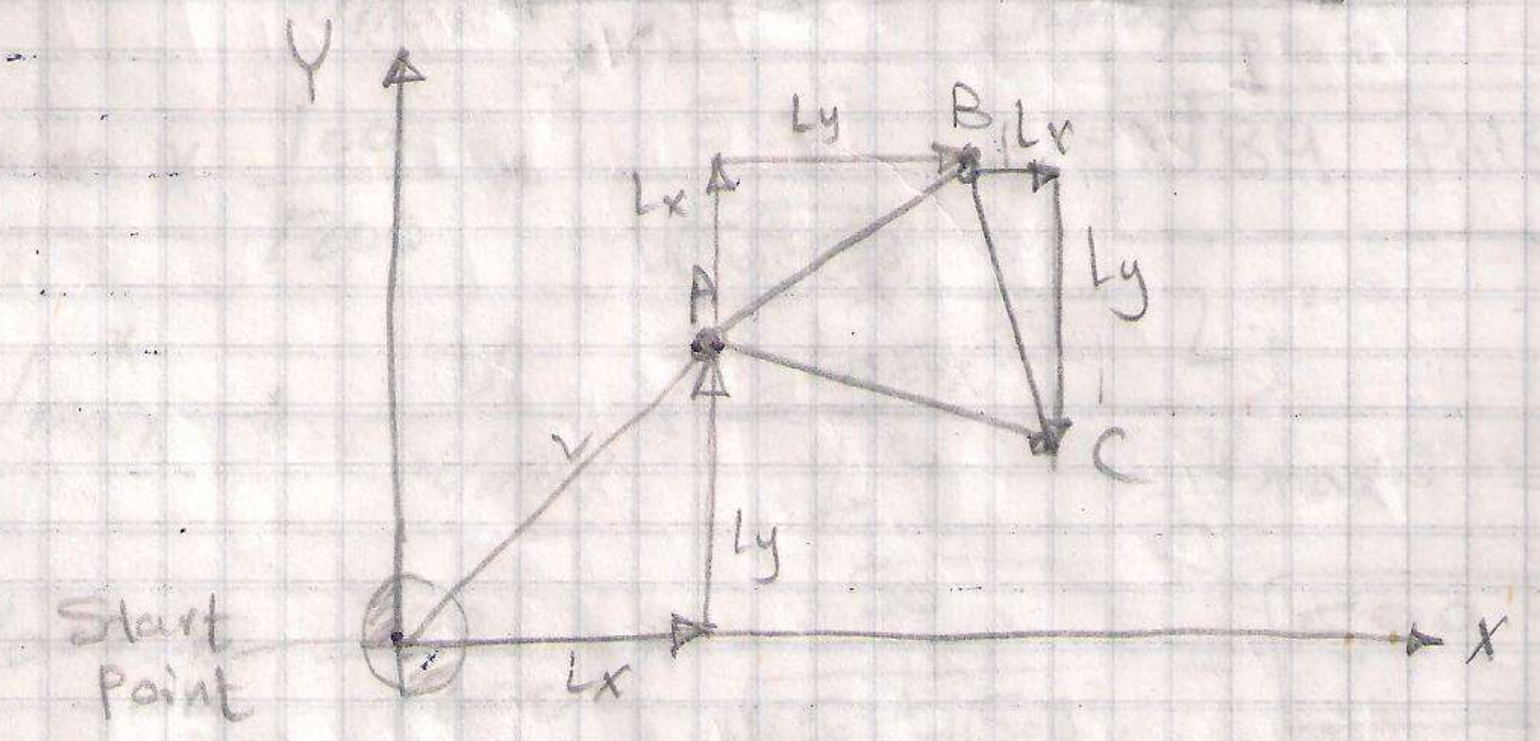
Case II linear interpolation

Puls rate at any Point

$$V_x^* = V^*_{max} * \frac{V_L}{V_{max}} * \frac{L_{max}}{L} * \frac{L_x}{X_{max}}$$

$$V_y^* = V^*_{max} * \frac{V_L}{V_{max}} * \frac{L_{max}}{L} * \frac{L_y}{Y_{max}}$$

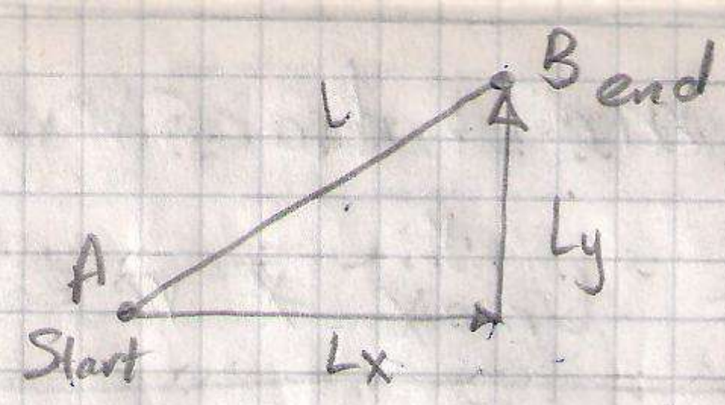
Example



لحساب ال Puls rate عند A, B, C لازم نحدد ال Start Point

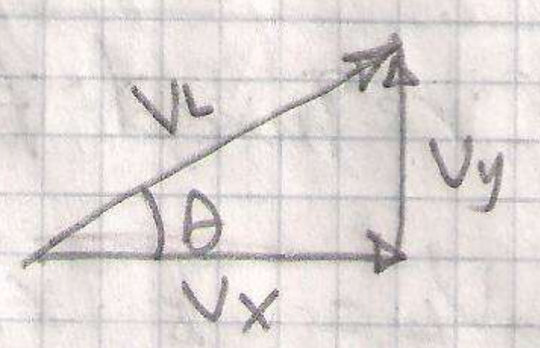
ونرسم المسار ونحسب L_x و L_y و L لكل مقطع

for check results



$$V_x = V_x^* * \text{resolution}$$
$$V_y = V_y^* * \text{resolution}$$
$$V_L = \sqrt{V_x^2 + V_y^2}$$

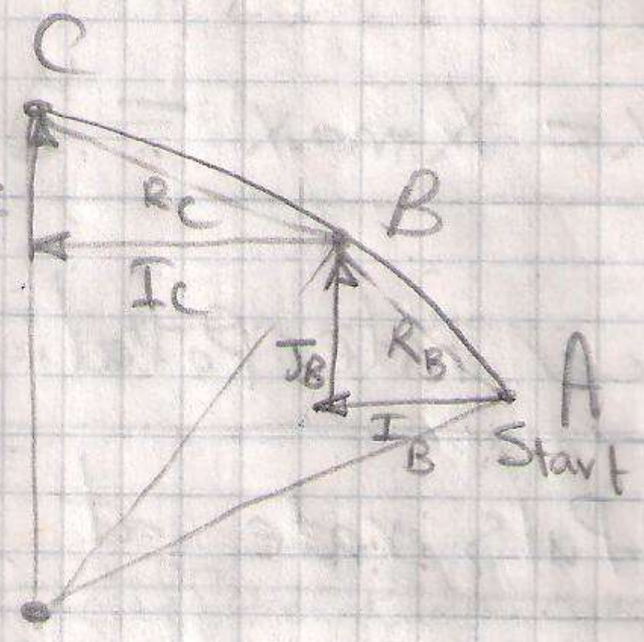
mm/s



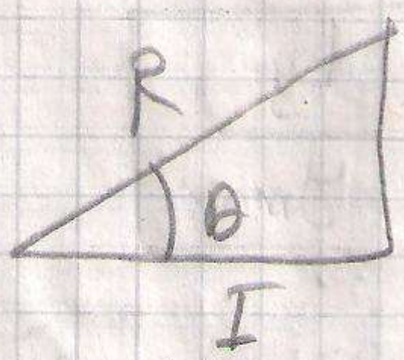
Cas 2 Circular interPolation :

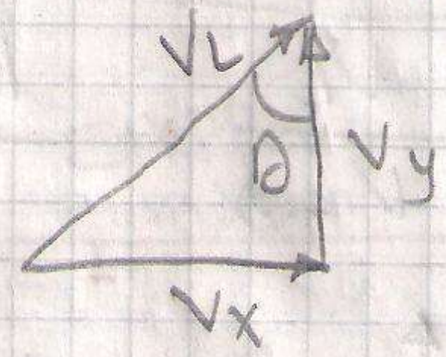
$$V_x^* = V_{max}^* * \frac{V_L}{V_{max}} * \frac{R_{max}}{R} * \frac{J}{J_{max}}$$

$$V_y^* = V_{max}^* * \frac{V_L}{V_{max}} * \frac{R_{max}}{R} * \frac{I}{I_{max}}$$



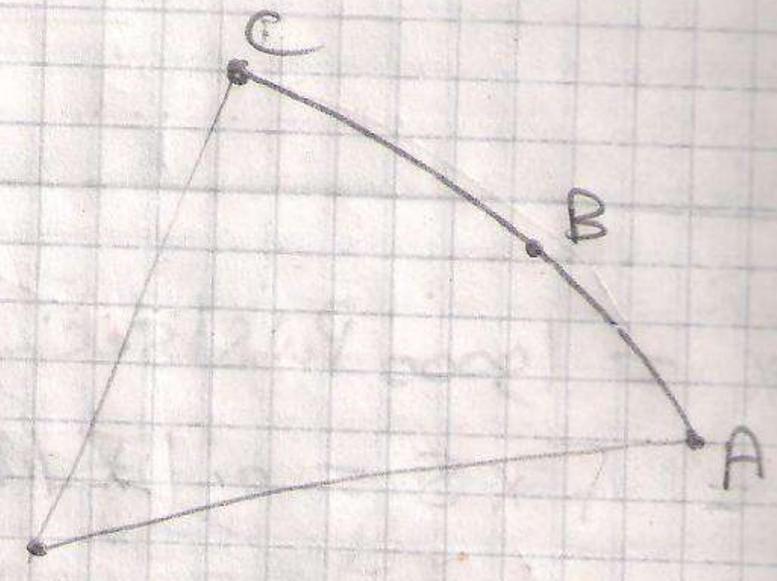
$$R_{max} = I_{max} = J_{max}$$





[5] In a CNC M/C the maximum transverse speed is 20 m/min - the maximume Pulse rate is 80000 if required feed in the Part Program is 100 while the machine is cutting the arc shown wh Puls rate at the Points A, B & C for each of two drives X & Y

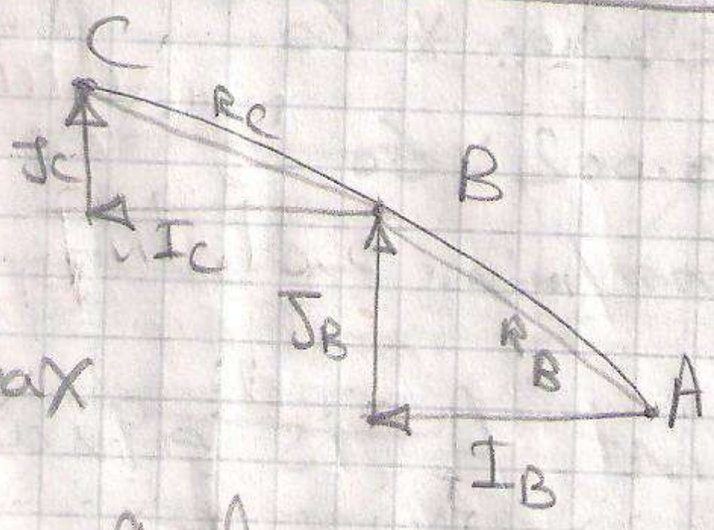
Start from A



V_{max}

assume that

$R_{max} = I_{max} = J_{max}$



$V_{max} = 20000$

$V^*_{max} = 80000$

$V_L = 100$ mm/

$\Rightarrow$ Pulse at Point (A) is equal zero

$\Rightarrow$ Pulse at Point (B) &

$$V_X^* = V_{max}^* \frac{V_L}{V_{max}} * \frac{R_{max}}{R_B} * \frac{J_B}{J_{B_{max}}}$$

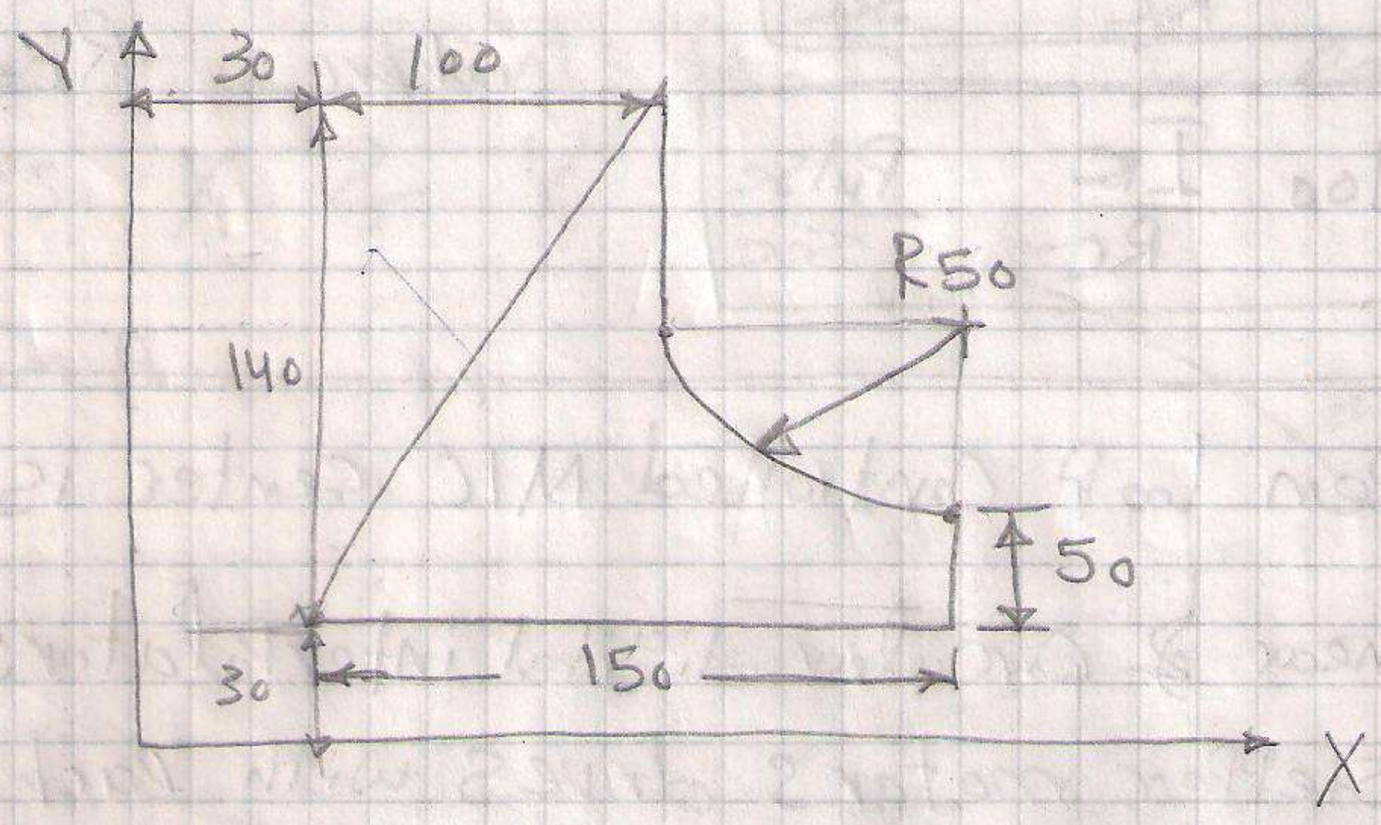
$$= 80{,}000 * \frac{100}{20{,}000} * \frac{J_B}{R_B}$$

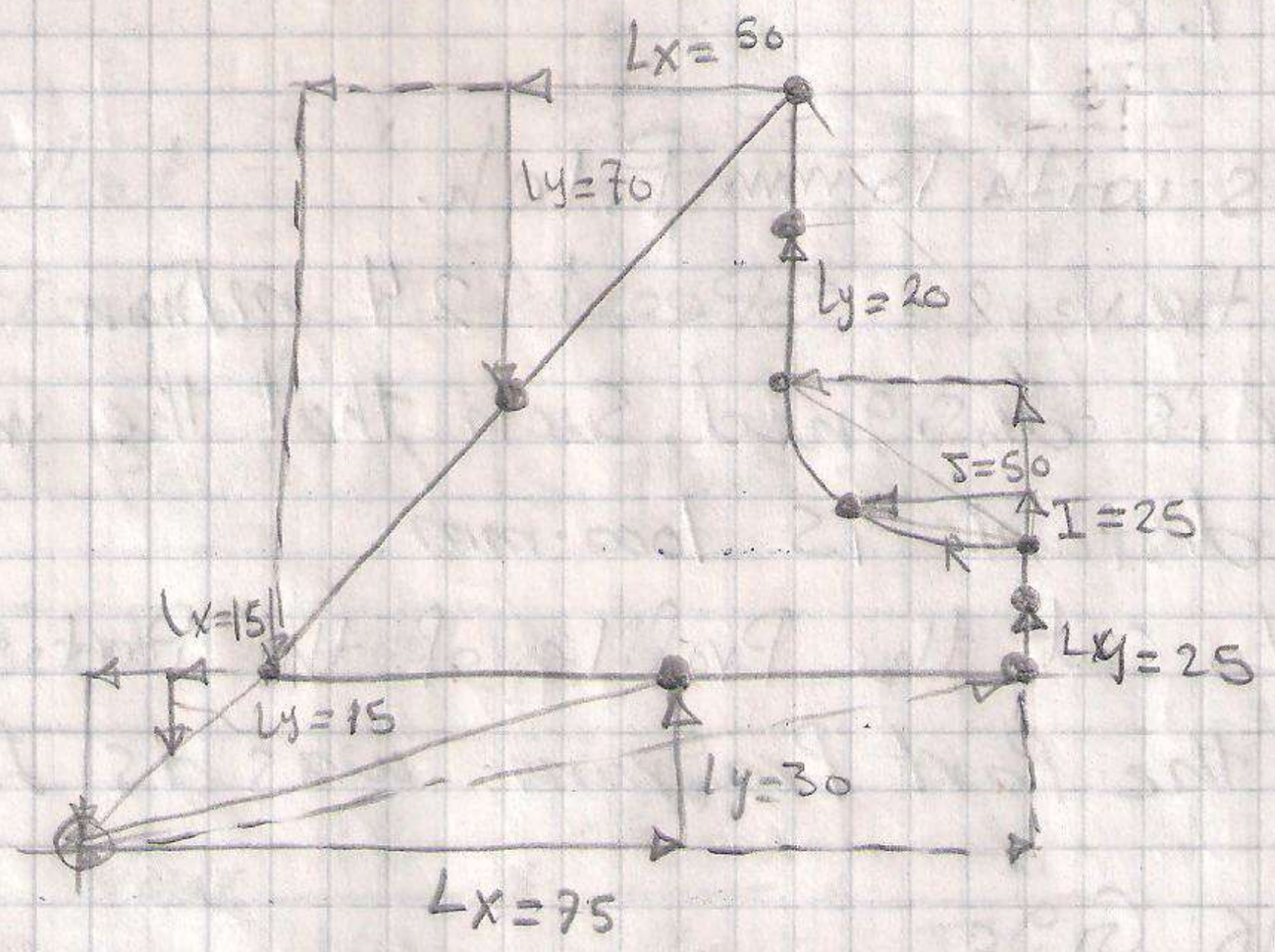
$$\boxed{V_X^* = 400 \frac{J_B}{R_B} \text{ Puls/sec}}$$

$$V_y^* = V_{max}^* * \frac{V_L}{V_{max}} * \frac{R_{max}}{R_B} * \frac{I_B}{I_{B_{max}}}$$

$$\boxed{V_y^* = 400 \frac{I_B}{R_B} \text{ Puls/sec}}$$

Calculate the Pulses Generated by the Velocity P
Computer to each of the X & Y drivers at the
Mid Points of each of the Passes created by bloc
N120, block N130, block N140, block N150, block N160
& block N170.





Pathes through mide Point of each block

Pitch = 10mm
Pulsturn = 1.8°
Vmax = 24,000
Lmax = 1000 m

$$\text{Reslution} = \frac{\text{Pitch} * \text{Pulsturns}}{360} = \frac{10 \times 1.8^{\circ}}{360} = \boxed{0.05\ \text{m}}$$

$$V_{max}^{*} = V_{max}^{*} * \text{Reslution} * 60$$

$$24{,}000 = V_{max}^{*} * 0.05 * 60$$

$$\therefore V_{max}^{*} = \boxed{8000\ \text{Puls/sec}}$$

for linear interpolation $V_L = F = 100$ mm/min

for Circular interpolation $V_L = F = 50$ mm/min

Puls rate at Mid Points for

Block N120

$$V_x^* = V_{max}^* * \frac{V_L}{V_{max}} * \frac{L_{max}}{L} * \frac{L_x}{X_{max}}$$

assume $L_{max} = X_{max} = 1000$ mm

$$V_y^* = V_{max}^* * \frac{V_L}{V_{max}} * \frac{L_{max}}{L} * \frac{L_y}{Y_{max}}$$

where: $V_{max}^* * \frac{V_L}{V_{max}} = \frac{100}{3}$ Puls/sec

$$\therefore V_x^* = 100/3 * \frac{75}{\sqrt{(75)^2 + (30)^2}} \simeq \boxed{31 \text{ Puls/sec}}$$

$$V_y^* = 100/3 * \frac{30}{\sqrt{(75)^2 + (30)^2}} \simeq \boxed{12.5 \text{ Puls/sec}}$$

Block N130

$$V_y^* = \frac{100}{3} * \frac{25}{25} \simeq \boxed{33.5 \text{ Puls/sec}}$$

$V_x^* =$ Zero

Block N140

$$V_x^* = V_{max}^* * \frac{V_L}{V_{max}} * \frac{R_{max}}{R} * \frac{J}{J_{max}}$$

$$V_y^* = V_{max}^* * \frac{V_L}{V_{max}} * \frac{R_{max}}{R} * \frac{I}{I_{max}}$$

$R_{max} = I_{max} = J_{max}$

$$V_x^* = 50/3 * \frac{50}{\sqrt{(50)^2 + (25)^2}} = \boxed{15 \text{ Pulse/sec}}$$

$$V_y^* = 50/3 * \frac{25}{55.9} = \boxed{7.5 \text{ Pulse/sec}}$$

Block N150

$$V_y^* = \frac{100}{3} * \frac{20}{20} = \boxed{33.3 \text{ Puls/sec}}$$

$$V_x^* = \text{Zero}$$

Block 160

$$V_x^* = \frac{100}{3} * \frac{50}{\sqrt{(50)^2+(70)^2}} = \boxed{19.5 \text{ Puls/sec}}$$

$$V_y^* = \frac{100}{3} * \frac{70}{86} = \boxed{27 \text{ Puls/sec}}$$

Block 170

$$V_x^* = \frac{100}{3} * \frac{15}{\sqrt{(15)^2+(15)^2}} = \boxed{24 \text{ Puls/sec}}$$

$$V_x^* = V_y^* = \boxed{24 \text{ Puls/sec}}$$